not one was found really one hundred years old. In Canada the census at the same time showed 421 centenarians. Of these, only 82 could prove their citizenship, and of these only 9 were really one hundred years old, while it was probable that a still smaller proportion of the others were genuine centenarians. The 1886 census of France records 184 centenarians,— 66 men and 118 women. This number, though not in excess of the usual record, has aroused suspicion, and led to further inquiry.

The reasons for falsification are quite evident. A peculiar and innocent kind of pride; ignorance of their real age; the assurance of being very, very old, — all these, in passing from mouth to mouth, become cases of advanced centenarianism. Upon closer inquiry, of these 184, only 83 stood the slightest investigation; of the remaining 101, many were really very old, but not one hundred years old; and three young persons gave in their answers as a joke. A reference to the birth register showed that 49 of the alleged centenarians were really of the following ages: 1 of 77, 2 of 78, 1 of 79, 1 of 80, 1 of 82, 1 of 86, 1 of 89, 4 of 90, 4 of 91, 6 of 92, 1 of 93, 4 of 94, 6 of 95, 5 of 96, 2 of 97, 2 of 98, and 7 of 99. Of the rest, no reliable information was obtainable.

Of the 83, only 16 showed their baptismal records to the authorities at Paris; the other 67 did not send their records of baptism to Paris (in some cases these were seen at their houses), but produced the less satisfactory evidence of a marriage certificate, etc. Of these 83 (containing an uncertain number of fraudulent cases, no doubt), 31 were men and 52 women. Of the men, 6 had never married, 2 were married, and 23 widowers: corresponding numbers for the women were 10, 1, and 41. Again: 44 were just 100 years old, 16 were 101, 7 were 102, 6 were 103, 5 were 104, 3 were 105, and 1 claimed to be 112 and another 116 years old, yielding an average age of 101 years and 4 months. The veteran of 116 years is reported to be in good health in June last at 118 years. But dismissing this as well as the preceding case, 105 may be regarded as the extreme limit of life in France.[1]

The profession of 59 of the 83 was ascertainable: 22 were farmers and laborers, 9 were handicraftsmen, 8 were land-holders, 6 were cooks or domestics, 5 were merchants, 2 were shepherds, and of the other 7, 1 was a teacher, 1 an insurance-agent, 1 a hotel-keeper, 1 a midwife, 1 a widow of a costumer, 1 a widow of a doctor, and 1 a widow of a stone-cutter. They can also be classified as follows: those living in actual poverty, 22; of very limited means, 10; of a modest fortune, 7; in easy circumstances, 6; wealthy, 1; present fortune unknown, but quite limited in means (as can be deduced from their former professions), 37. The fact that so large a proportion of centenarians come from the poorer and the hard-working classes is a striking one, and is borne out by the statistics of other countries. Their habits of life, too, when such information is obtainable, point to a simple, wholesome diet, much outdoor activity, and little care.

Another means of gauging the number of centenarians is by the number of annual deaths of persons of 100 years or more. In the twenty years from 1866 to 1886 the deaths of 1,474 such persons are reported (553 men and 921 women), or about 73 such deaths annually (27 men, 46 women). This justifies the conclusion that about 70 centenarians for France is a liberal if not a maximum estimate, and the every-day reports are greatly exaggerated. The average annual death-rate of centenarians for the years 1855 to 1885 is 87, or 1 to about 15,000 of the population, — a doubtlessly greatly exaggerated account.

A topic of interest to French but hardly to American readers, is the local distribution of the centenarians in the different departments of France. The southern portion, and especially the region bordering upon the Pyrenees, is particularly fruitful of centenarians.

While these statistics serve to correct popular estimates, they are themselves not rigid enough to be accepted as they stand. Many suspicious points still occur: the preponderance of women over men is too great to be capable of a biological explanation; the preponderance of the working-classes may be a sign of ignorance or of mendacity as well as of longevity; and so on. At any rate, the general conclusion seems warranted that there are really very few centenarians to a million souls.

[1] One of these patriarchs stands at the head of five generations, and counts ninety-five children and grandchildren; another has seventy direct descendants.

THE TOPOGRAPHIC MAP OF NEW JERSEY.

MENTION has been made in *Science* from time to time of the topographic maps of different parts of the country, and in particular of the numerous sheets that constitute the 'Atlas of New Jersey.' The seventeen sheets, on a scale of a mile to an inch, and with contours every ten or twenty feet, covering the whole State, have all been issued, and are now followed by two general maps of the State on a scale of five miles to an inch. The first of these gives counties, townships, cities, villages, railroads, and many of the roads, but gives no indication of the topographic relief. The second has the railroads and a small number of towns, and indicates the topography with great nicety by a series of tints of increasing darkness with increasing height. Thus for the first time in this country is the form of one of our States duly portrayed.

The map is a picture that the geographer may lean over for hours with increasing interest. The features of the State are brought out with perfect distinctness. The broad plains of the southern half, where the railroads run along the flat divides between the streams, is shown in the strongest contrast with the rugged highlands of the northern half, where the valleys alone afford highways. The curiously curved ridges formed by the trap sheets of the triassic area appear with their well-marked individuality. The faintly submerged valleys of all the salt-water coast-line are distinctly revealed by the estuary-like form of the lower stream-courses; and all this not merely in outline, as it appears on ordinary maps, but with accurately determined contours, giving the quantity as well as the quality of the form of the State. Besides this, the map is very suggestive in the way of displaying hitherto unsuspected problems, whose very quantities were unknown before. Now they take definite shape, and call for solution. Look, for example, in the southern half of the State, at the general line of divides between the streams flowing into the Atlantic and those flowing into the Delaware, and note not only the great bend, but also the diminution in height of the line at the head of the Rancocas: has this not some connection with the bend of the Delaware from its direct course at Bordentown? See the oblique truncation of Sourland Mountain on a line, that, when extended, leads to the similarly oblique truncation of the Watchung Ridges: is there not some great dislocation responsible for this coincidence? Notice the heavy morainic barrier that bisects the Passaic basin within the Watchung Ridges: the present line of escape for the Passaic from the Great Swamp that lies outside of the moraine must have been adopted since the glacial period. It is only when the relief of the ground is given quantitively, as by contours, that problems such as these can be discussed satisfactorily: hence the great advance that geography may count upon when accurate contoured and shaded maps are published for other States.

This map of New Jersey recalls a similar one of Scotland, prepared by Bartholomew, with explanatory text by James Geikie, and published in the first number of the *Scottish Geographical Magazine* a few years ago. Professor Geikie did good service to geography in calling attention to the absolute need of good maps, showing the real form of the country that one has to study; and we would gladly repeat and emphasize every word that he says as to their educational value. But there is another curious correspondence between the two cases: Geikie's physical description of the Scottish highlands and lowlands applies with extraordinary accuracy to the northern third of New Jersey. In both, the highlands are distorted and ancient hard rocks, which have been heavily eroded, and whose general upland surface is an old lowland, elevated, and now deeply consumed by valley-making streams. Both highlands are separated from the lowlands that lie south-east of them by a great fracture, with up and down throw on corresponding sides. Both lowlands owe their present moderate elevation not so much to any depression that they have suffered as to the broad wasting-away of their relatively soft rocks; while the hard crystallines of the highlands have wasted more slowly, and still retain much of the height that the lowlands have lost. The ridges that rise above the lowlands, both in Scotland and New Jersey, are beds of volcanic rock that have, like the highlands, wasted slowly, so as to stand up in strong relief above the softer rocks on either side. There are, of course, differences in plenty

between the two regions, but the correspondences are certainly extraordinary.

We shall hope soon to hear that the excellent and practical work of the New Jersey Survey has been appreciated by the school-boards of that State, and that copies of this new topographic map and of the appropriate local sheet of the State atlas have been placed in all the high schools and academies. Teachers could then carry on the modern reform in geographic teaching beyond its simple first step, which involves a map of the school-yard and home town, to the more difficult second step, in which correct maps of larger areas are needed. Until this is generally possible and actual, reform in geographic teaching will not go far beyond the merest elements of the subject. If Professor Cook is as successful in putting the State maps into practical use as he has been in surpervising their preparation, we shall owe him a double debt.

W. M. D.

TISSOT'S THEORY OF THE PROJECTION OF MAPS.

THE question as to what projection to select for a certain map is one of great importance to the cartographer. As is well known, the earth's surface cannot be represented on a plane sheet of paper without distorting the lengths of lines, and without altering the size of surface or of angles; and for this reason it becomes the duty of the cartographer to select a projection, or a method of representing the curved surface on a plane, by which the distortions and alterations become as small as possible. Merit is due a French geographer and mathematician, M. A. Tissot, for having first pointed out a method by which this problem can be easily solved. Unfortunately his book, which was published in 1881,[1] is little known, and therefore the necessary process of replacing the old projections, which he has proved to be inadequate, by new and better ones, is making hardly any progress.

The principle which underlies his researches is so clear and simple, that it may be stated here. Tissot assumes an infinitely small circle on a curved surface. If this surface is represented on a plane, the circle assumes the shape of an ellipse, on account of the unavoidable distortion. The great and small diameters of this ellipse are a and b, and their ratio is a measure of the angular distortion, while their product is a measure of the alteration of surface. The ratio between a and the radius of the original small circle, r, is a measure of the alteration of scale. Tissot shows how to compute the length of the axes of this ellipse, which he calls the indicatrix, as indicating the distortion, and how to determine their direction.

This general theory is next applied to the construction of maps. For any law according to which a system of meridians and parallels is constructed, we can compute a and b as functions of latitude and longitude, and thus a means is obtained of studying the distortions all over the surface of the map.

Maps are made to serve various purposes. In many cases it is necessary that a square inch on one part of the map should represent the same area as a square inch on any other part of the map, or, as it is generally expressed, that the areas should be preserved. Projections of this kind are called 'equivalent,' while Tissot introduces the expression 'authallic.' It is evident that every projection in which the indicatrix-ellipse is equal to the small circle, is equivalent. In other cases it is desirable that each small part of a map be similar to the corresponding part of the earth. This is possible only when the indicatrix is a circle; that is, when $a = b$. These projections are called by Tissot 'autogonal,' as the angles are preserved. In still other cases we do not mind an alteration of angle and surface, but wish to preserve the length of lines as much as possible. For this purpose the ratio of a, b, and r must be as near 1 as possible. Tissot calls projections in which angles and surfaces are altered 'aphylactic.'

The problem, according to this, is very simple. According to the purpose for which a map is intended, we choose one of the three classes of projections. It is the task of the cartographer to select the projection for a map so that, if one property is preserved, the others are changed as little as possible. If, for instance, the areas are preserved, the angles must be altered as little as possible. A projection which has this property is called by Tissot 'perigonal,' while an autogonal projection in which the alteration of surface is a minimum is called 'perihallic.' We have seen that the distortion is a function of latitude and longitude. If, then, a country of limited extent is given, we must study this function over the whole area of the map; and, as there are an infinite number of each class of projections, we are able to select the function so that the unavoidable distortion of one of the elements becomes a minimum.

The last case, that of 'aphylactic' projections, has been treated by Airy in his projection by balance of errors; but the theory of these projections and their application to certain areas has first been given by Tissot. His admirable work must form the basis of all future cartographic work.

The importance of his researches may be understood by his discussion of the distortions of the map of France. The great map of the war department of that country is constructed in Bonne's projection; the map being equivalent, and the maximum alteration of angle being 18 minutes, and the greatest distortion of scale $\frac{1}{880}$. These would have been 10′ 30″ and $\frac{1}{660}$ respectively, if a more suitable central meridian had been selected; but they would have been reduced to 25 seconds and $\frac{1}{110}$, if Tissot's principles had been applied.

It is to be hoped that the thorough study of his work will lead to the adoption of better projections than those which are at present in use.

[1] *Mémoire sur la Représentation des Surfaces et les Projections des Cartes Géographiques.* Par M. A. TISSOT. Paris, Gauthier-Villars.

SCHOOL-WORK AND EYESIGHT.

Five Per Cent of Near-sighted Children in an Old, Badly Illuminated and Ventilated School-Building, and only 2.8 in a New, Well-arranged Building. — School Life, according to Dr. Tiffany of Kansas City, has Little or Nothing to do in the Development of Ocular Anomalies.

IN the chapter entitled 'Our School Systems,' which is one of the most interesting and suggestive of all those that will accompany the forthcoming annual report of the United States commissioner of education, the effect of school-work on eyesight will be very fully discussed, chiefly in extracts from the reports of city school superintendents.

Mr. George Howland, superintendent of Chicago schools, says: —

"In the old school-rooms, and we need not go far back for them, the light was often so insufficient, that much harm undoubtedly resulted to the eyes of the children. But in our newer buildings so much thoughtful attention has been given to this subject, that the evil no longer exists there. Pupils, too, have been allowed to study with too little regard to position, and with the object too near the eye; perhaps with the result of myopia in some cases, but by no means, in my judgment, to the extent often charged.

"The oculist is too definite, and too certain in his knowledge. Why should the book or paper always be 'fifteen inches from the eye'? Five feet seven may be the average height of a man, and eight the right number for his boot; but is he to be considered deformed, or a monstrosity, who is five feet six, or who wears a number seven or nine?

"Of over eighty thousand children in our schools, I have never seen one voluntarily take that distance, and have eminent professional opinion that such an enforced rule would work more harm than ever our neglect has done. Nothing will lie so unblushingly as figures."

The following, from the report of the board of education, describes the results of a recent examination of the eyes of the pupils of two of the leading public schools of Memphis, Tenn: —

"The eyes of 681 pupils have been examined. Of these, 588 had perfect sight, 60 had imperfect sight from general causes, and 30 had impaired vision from eye-strain. It is interesting to trace the gradual increase of this form of impaired sight (near-sightedness) from the primary classes, where it is hardly noticeable, to the highest grade, where it reaches fifteen per cent. In this particular my results are similar to those obtained by examiners in this and other countries. But a point which should not be overlooked is this, — that my examinations were confined to pupils in two different school-buildings, each of which may be taken as a sample of its class. The Market Street building has been recently constructed,